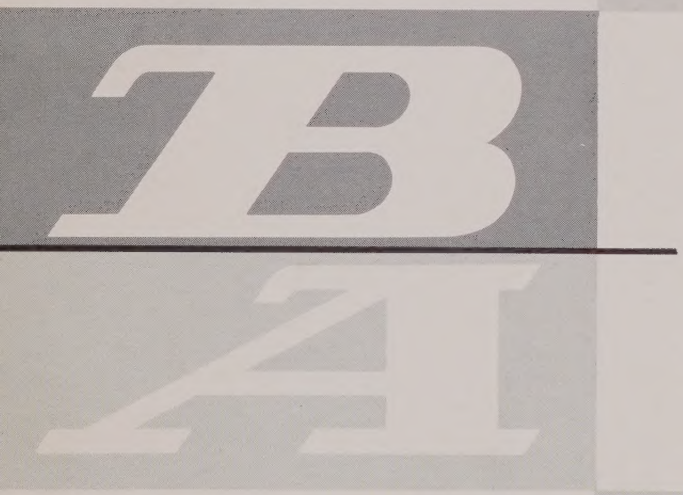


Instruction Manual

Model 219

LINEAR PREAMPLIFIER

and

Model 218

LINEAR AMPLIFIER

Baird-Atomic, Inc.

Cambridge, Mass. USA

Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_06604

Instruction Manual

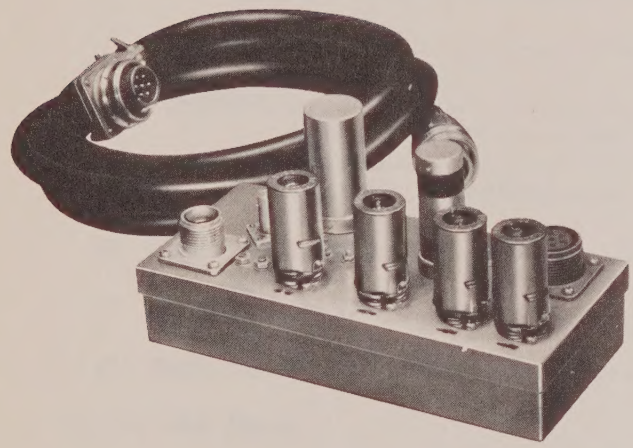
Model 219

LINEAR PREAMPLIFIER

and

Model 218

LINEAR AMPLIFIER



Baird-Atomic, Inc.

33 University Road, Cambridge 38, Massachusetts

Model 218 and 219
Table of Contents

I General Description 1
Purpose 1
Variant Models 1
Specifications 1
Brief Circuit Description 3

II Installation 4

III Operation 5
Jacks and Plugs 5
Controls 6
Operation Suggestions 8

IV Circuit Description 9

V Maintenance 12

VI Parts Lists 19

Figures and Tables

Table V-1 Tables of Model 218 and 219 Voltages & Resistances 14

Fig. III-1 Typical Connections 7

Fig. V-2 Model 219 Preamplifier, Top View: Location of Components 16

Fig. V-3 Model 219 Preamplifier, Bottom View: Location of Components 16

Fig. V-4 Model 218, Top View: Location of Components 17

Fig. V-5 Model 218, Bottom View: Location of Components 17

Fig. V-6 Model 218, Component Boards: Location of Components 18

Schematics

Model 219
Model 219B
Model 218
Model 218B

MODEL 219 LINEAR PREAMPLIFIER
and
MODEL 218 LINEAR AMPLIFIER

MODEL 218 — LINEAR AMPLIFIER

SECTION I — GENERAL DESCRIPTION

Model 218 Linear Amplifier and 219 Preamplifier are based on the Oak Ridge Model A1D design. They will amplify the pulse output of radiation detectors and deliver these pulses at an impedance and power which will operate various equipment for analyzing, counting, and registering these pulses. These amplifiers are linear, their ouput amplitude being approximately proportional to the input. The linearity as well as stability are provided by the feedback circuits. A delay line in the Model 218 provides a pulse of optimum shape for analysis and counting.

Description of Model Variants

The Model 219B Preamplifier is a variant form of the Model 219A with circuit modifications to make it capable of driving 50′ or 100′ cables as well as a 5′ cable. The regular 5′ cable is supplied with the instrument and the longer ones may be purchased separately from Baird-Atomic. See schematic at the end of the book for details.

The Model 218B Amplifier is a variant form of the Model 218 with a circuit modification to supply sufficient filament power to the Model 219B. It is available in two models: one with a switch to permit operation with 5′ or 50′ cable and another to permit operation with 5′ or 100′ cable. See schematic at the end of the book for details.

Note that a Model 218 when supplied as a component in the Model 513 Spectrometer differs in one respect from a conventional Model 218. The delay line is 24′ which when short-circuited provides a 2 μsec delay instead of the regular 12′ delay line which when short-circuited, provides a 1 μsec delay. This delay line provides a somewhat better pulse-shape for the Model 510 Single-Channel Analyzer.

A. Specifications for Model 219 Preamplifier

Rise Time: 0.25 μsec maximum

Fall Time: 10 μsec minimum

Maximum Gain: 30 x

Bandwidth: 2 mc

Input Polarity: Positive or Negative

Input Impedance: 1000 megohms

Linearity: 2%

Power Requirements: +95 V at 20 ma., 6.3 V AC at 0.7 amps, +265 V (ionization chamber collection voltage).

Receptacles: High Voltage: MHV (JK-1)
Signal Input: HN (JK-21)
Preamplifier and Signal: AN3102-16S-1S (JK-31)

Cables Supplied: B-A #1 (preamplifier power and signal)

Dimensions: $7\frac{5}{16}$" d x $3\frac{7}{16}$" w x $3\frac{1}{2}$" h

Net Weight: 2 pounds

B. Specifications for Model 218 Amplifier

Pulse and Gain Characteristics:

Bandwidth	Rise Time	Decay Time	Noise Level	Noise Level with Preamplifier	Maximum Gain High Level
Delay Line (2.0 mc)	0.2 μsec	0.8 μsec	1.0v max	4v peak to peak	1,600
0.5 mc	0.7 μsec	5.0 μsec	1.0v max	8v peak to peak	6,000
0.1 mc	5.0 μsec	5.0 μsec	1.0v max	15v peak to peak	12,000

Input Polarity: Negative (simple revision noted on schematic to accept positive pulses)
Impedance: 2,000 ohms

Output: High Level
Impedance: 150 ohms
Linearity: 1% for 0 to 90v output
Amplitude Range: 0 to 90v
Low Level
Impedance: 150 ohms
Linearity: 1%
Amplitude Range: 0 to 2.7v
Pulse Height Selector Impedance: 4,700 ohms
Linearity: 1%
Amplitude: 60v negative

Linearity: Within 1% from 0 to 90 volts output

Noise: Less than 1.0 volt at maximum gain on all bandwidths

Controls (All mounted on front of panel): Power On-Off
Coarse Gain: 64, 32, 16, 8, 4, 2
Fine Gain: Continuously variable between Coarse Gain settings:
Bandwidth: Three positions — delay line (2.0 mc), 0.5 mc, 0.1 mc. A short-circuited delay line is used to produce relatively flat-topped pulses at the amplifier output.
Pulse Height Selector: Helical potentiometer with a "Micro-dial" for control of pulse height discriminator at the high level output. Pulses above selected level will cause discriminator to produce a negative 60-volt pulse of approximately 0.5 microseconds duration into a 1 megohm load.
Use-Test: For use with test pulse generators

External Power: +265v at 20 ma., 6.3v AC at 0.7 amps, +265v DC bias (for ionization chamber or other low level detector)

MODEL 219 LINEAR PREAMPLIFIER
and
MODEL 218 LINEAR AMPLIFIER

Receptacles: Signal Input: UHF (JK-3)
High Level Output: UHF (JK-3)
Low Level Output: UHF (JK-3)
Pulse Height Selector: UHF (JK-3)
Preamplifier Connector: AN3102-16S-1S (JK-31)

Power Requirements: 115v AC, 50/60 cycles, at 1.5 amps

Dimensions: 19" w x 8¾" h x 13" d

Net Weight: 58 pounds

Shipping Weight: 75 pounds

Brief Circuit Description

The Model 219 Preamplifier is a three stage feedback amplifier with a cathode-follower output stage.

The Model 218 consists essentially of two feedback loops, each comprising three stages. By differentiation, the output voltage is made to reproduce the shape of the original current pulse. Three bandwidths can be selected: 0.1 mc, 0.5 mc, and 2 mc (DELAY LINE). Coarse and fine gain controls provide a continuous control of over-all gain. Between the first and second feedback loops, a TEST Switch permits insertion of test pulses.

The Model 218, as shipped, is intended for the linear amplification of negative pulses. By means of a simple reconnection between the first and second loops, however, it may be used equally well for amplification of positive pulses.

A pulse-height selector, variable from approximately zero to 100 volts, is also included for selecting output pulses whose amplitude is greater than the setting of the selector.

SECTION II — INSTALLATION

Location

The equipment is self-contained. It may either be used in its own cabinet placed on a bench or table, or it may be removed and mounted in a relay rack. No side access is required. Therefore, it can be placed next to a wall or between other units. There should be a back clearance behind the equipment sufficient to make connections and provide adequate ventilation.

SECTION III — OPERATION

Jacks and Plugs

A. Model 219 Preamplifier

Schematic Designation	Jack Designation and Type	Purpose
J1	High Voltage (BNC)	Introduces high voltage for radioactivity detector.
J2	Signal Input (HN)	Introduces signal from detector.
J3	Preamplifier (AN)	Introduces low voltage from amplifier and couples output signal from preamplifier.
B. Model 218 Amplifier		
J2	Preamplifier (AN)	Introduces signal from preamplifier and couples low voltage to preamplifier
J3	Input (UHF)	Couples signal to amplifier in any applications in which preamplifier or preamplifier power is not required.
J4	PHS Out (UHF)	Couples discriminator output to counter, ratemeter, etc.
J6	Delay Line (UHF)	Introduces delay line into circuit; unplugged in .5 mc and .1 mc bandwidth positions.
J8	Test Input (UHF)	Introduces signal from test pulse generators when S4 (Test) Switch is in Test position.
J9	High Output (UHF)	Couples output to analyzer, etc.
J10	Low Output (UHF)	Couples output to oscilloscope, etc.
J11	AC receptacle	For 115V, 60 cps.

Controls, Adjustments, and Indicators: Model 218

Name	Function	Schematic Designation
BANDWIDTH Switch	Selects bandwidth, input time constant, and gain for amplification of input pulse at optimum S/N ratio for short, medium, and long input pulses.	S1
COARSE GAIN	Provides gain adjustment in 6 steps, each step being an exact factor of 2.	S2
FINE GAIN Control	Provides continuous gain adjustment from 50% to 100% of maximum to cover the interval between steps of the COARSE GAIN Switch.	R1
PULSE HEIGHT Control	Rejects pulses below a chosen amplitude and permits the passage of pulses which generate a uniform pulse for counting.	R43
POWER Switch	Turns On and Off all filament and plate-power circuits.	S3
TEST	When in the TEST position, permits insertion of test pulses on grid of V4.	S4
Power Indicator	Indicates when lit that plate and filament power supply is energized.	I1
[Internal]	Adjusts amount of feedback, hence amplifier gain.	R24C
[Internal]	Adjusts transient response in delay line position.	C14

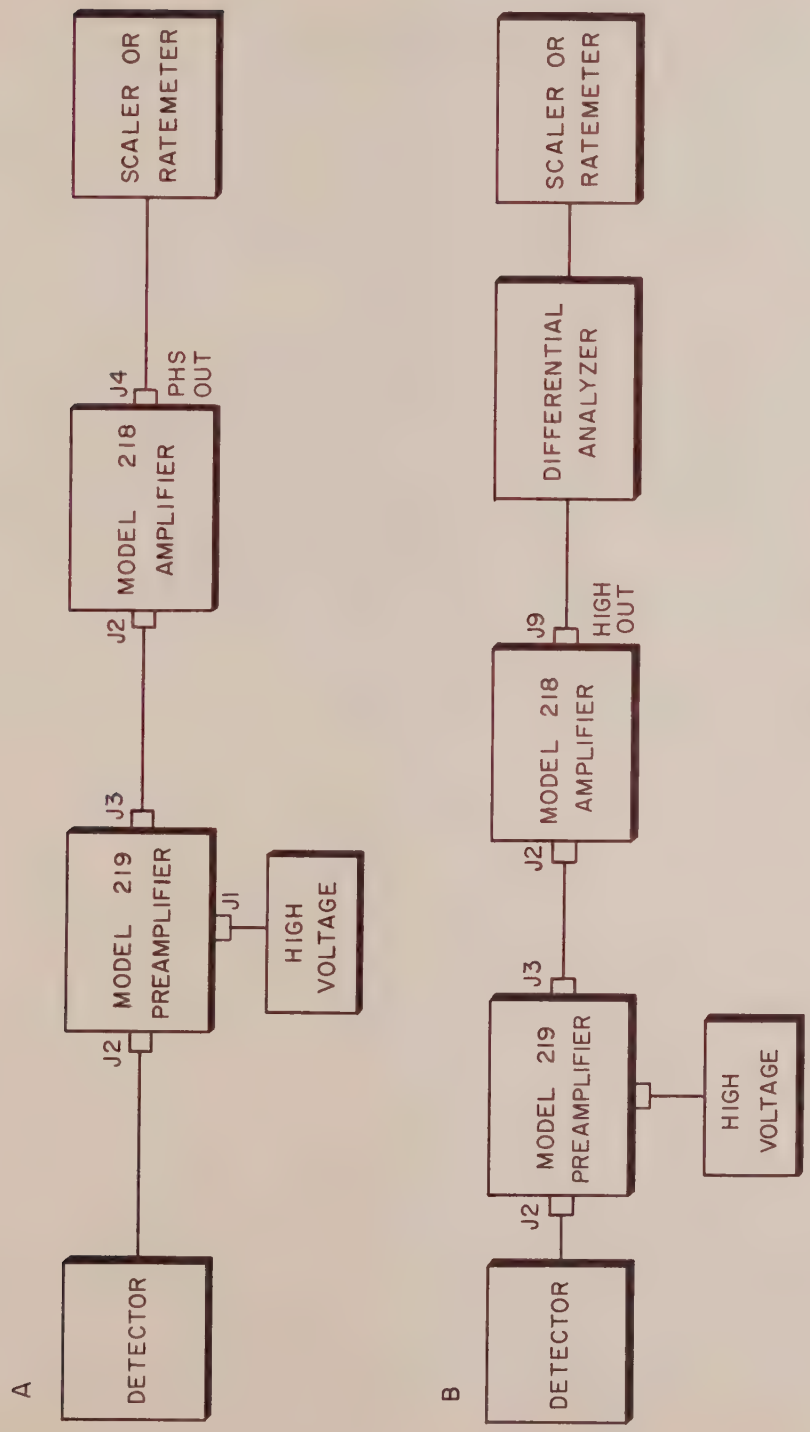


Fig. III-1 Typical Connections

MODEL 219 LINEAR PREAMPLIFIER
and
MODEL 218 LINEAR AMPLIFIER

Figure III-1 shows the use of Model 219 and 218 in typical systems and and indicates the proper use of their connectors. It is generally desirable to set the RISE TIME selector for the shortest pulse rise time of .2μs (defined as the time between .10 and .90 of full amplitude). However, as the specifications show, such a setting also gives the smallest overall amplification (X1600). This may be sufficient amplification for pulses from scintillation detectors, but pulses from ionization chambers and proportional counters may require the second or third setting. Generally, then, one would begin with the lowest setting of the BANDWIDTH selector and see whether increasing the COARSE and FINE GAIN controls will give enough amplification to allow one to take advantage of the wider bandwidth. Be certain the USE-TEST switch is on USE except when inserting a test pulse.

Pulse Height Selector: The size of pulse that will produce an output from the discriminator circuit depends on the amplifier gain settings as well as that of the Pulse Height Selector. If we recall that the discriminator output is a pulse of constant amplitude, it should be clear that there is no advantage to setting amplifier gain higher than is necessary to produce an output. On the other hand, too high a gain setting can overload the amplifier and make it insensitive for a short time following the pulse. In addition, especially on the medium and narrow bandwidths, a long positive overshoot may cause trouble by repeatedly triggering the PHS circuit. Therefore one should be careful to set the amplifier gain no higher than necessary to produce counts at the desired setting of the PHS. Note that inaccuracies in zero-setting and other sources of constant error make it advisable to operate the PHS dial on settings between 10 and 900, over which range the linearity of the discriminator is better than 2%.

See section IV, Circuit Description, for further suggestions on operation.

MODEL 219 LINEAR PREAMPLIFIER
and
MODEL 218 LINEAR AMPLIFIER

SECTION IV — CIRCUIT DESCRIPTION

MODEL 219 Linear Preamplifier

Model 219 Linear Preamplifier is designed to give Model 218 the added gain necessary for use with ionization chambers and other such high impedance, low level devices. With the combination of the two amplifiers, fast pulses from ionization chambers may be easily observed on an oscilloscope, used to trigger a scaling circuit, or fed to a pulse height analyzer.

INPUT CIRCUIT. The High Voltage receptacle is connected to the preamplifier input (82-804). Other input circuits for scintillation and proportional counters are shown on the schematic. For ionization chambers, using the regulated 265 volts supplied by the amplifier, a connection should be made from the terminal post of the 10 megohm resistor to the High Voltage receptacle or this voltage can be fed to the input connector through the high voltage receptacle.

The input capacitance has been kept to a minimum and components having low surface leakage are used in the input circuit. The input capacitance is approximately 20 micromicrofarads.

AMPLIFIER SECTION. Model 219 preamplifier uses four 6AK5 tubes and has a voltage gain of approximately 23. V1 and V2 are amplifier tubes. V3 is the feedback tube, the cathode voltage of V3 being returned to the cathode resistor of V1. By virtue of the feedback employed, a high order of gain stability is achieved. V4 is a cathode follower stage which reduces the effect of the capacitive loading of the preamplifier-amplifier cable. The cathode resistor of V4 is located in the amplifier (2200 ohms).

There is variable compensation across the feedback resistor to produce satisfactory transient response.

NOISE. The signal-to-noise ratio of the overall amplifier is determined in part by the first stage (V1) of the preamplifier. For a high ratio the input resistors R1 and R2 must be kept high and a good tube selected for the first stage. Circuit and tube noise is about 12-15 microvolts referred to the input. This varies considerably with the particular input 6AK5 used. A low noise tube is selected during testing.

POWER REQUIREMENTS. Model 219 requires 6.3 V AC at 0.7 amps., 95 volts DC at 20 ma, and 265 volts DC for ionization chambers. These voltages are supplied from the amplifier through a special six conductor cable. A separate filament transformer on the amplifier supplies the filament voltage to Model 219. One side of the heater circuit in the preamplifier is grounded to reduce external noise pick-up. The heater lead in the input tube (V1) is also shielded to reduce noise pickup.

MODEL 218 Linear Amplifier

INPUT CIRCUIT. The output from the Preamplifier is developed across a potentiometer (R1) and a fixed resistor (R2) in the amplifier chassis. The potentiometer is a fine gain control, providing adjustment of the signal between 50 and 100 per cent of maximum. In the signal path, the gain control is followed by a three position switch (S1 a & b) which provides the option of two differentiators, or a delay line pulse-shaping network. By differentiation, the voltage is made to produce the shape of the original current pulse. The DELAY LINE position feeds the signal to a 0.5 μsec delay line (RG65/u cable) which is short-circuited to provide a relatively flat topped 1.0 μsec pulses. These are desirable for use in differential pulse height analyzers.

NOTE: To use as a conventional amplifier on the 0.5 mc and 0.1 mc band widths, disconnect the delay line.

The differentiator and pulse shaper are followed by a coarse gain control (R3 to R8) with each step exactly a factor of 2, approximately equal in magnitude to the variation in the signal available by adjustment of the fine gain control (R1). The maximum gain is in the 64 position. Dial readings of the coarse gain control do not indicate absolute gain but can be used for relative gain settings to about two percent.

Due to the short time differentiation, the amplifier is not suitable for slow rising pulses such as those obtained from gaseous ion collection chambers. This disadvantage is offset by the many advantages of short time differentiation such as the following:

(1) The amplifier recovers quickly from a pulse, thus permitting high counting rates.
(2) A much larger ray-background can be tolerated when counting particles or, similarly, a large ray-background will not "pile-up" to give pulses as large as fission particles.
(3) Troubles with microphonics and hum are greatly reduced.

MAIN AMPLIFIER. The coarse gain control supplies a signal to the main amplifier, V1 to V6 inclusive. This amplifier consists of two separate three-stage amplifiers with feedback loops. The compensation on both feedback loops is adjustable; that on the first three-stage amplifier is used to adjust the rise time of the amplifier (S1b) and it is varied with the input differentiator switch; that on the second (C14) is used to make the transient response satisfactory in the DELAY LINE position.

Through the first feedback loop the input pulses may be either positive or negative. To avoid clipping on the pulse peaks, the signal at the grid of the output must be positive. The amplifiers are normally constructed so that the negative pulses at the input of the amplifier will be amplified as positive pulses at V6 and the output. However if the amplification of positive input pulses is desired, the signal into the second three-stage amplifier should be taken from the cathode of the tube V3 instead of the plate. This is an internal wiring change.

The gain in each of the feedback loops is approximately 100 in the DELAY LINE position. However, the overall gain will be smaller than the product of the gains in the two sections due to losses in the differentiator and output cathode follower.

The ouput of the main amplifier is available at "HIGH" and "LOW" output jacks. The output pulse heights at these two jacks are related by a factor of approximately 33 when properly terminated. The "LOW" output jack is intended for use with oscilloscopes. The "HIGH" output jack requires a 1K. 2W termination. Large capacitance on J9 will affect the shape and size of pulses received by the internal pulse height selector. Critical cable lengths may cause oscillation of the last feedback loop. When using the pulse height selector output, the "HIGH" level output should be terminated with the 1K, 2W resistor which is provided.

Model 218 contains an additional input jack, J8 and switch S4 for feeding calibrating signals into the last gain-of-100 feedback loop. Switch S4 should be placed in the "TEST" position to connect J4 through a 0.01 microfarad condenser to the grid of V4; R24C is a 2000 ohm potentiometer for adjusting the gain of this section to the required value. This additional input jack is provided to facilitate the calibraton of pulse height analyzers.

DISCRIMINATOR, or PULSE HEIGHT SELECTOR. A pulse height selector (PHS) is included on the amplifier chassis for measuring pulses between zero and approximately ninety volts. It measures the height of the video pulse appearing on the cathode of V6 and is therefore affected by the connections to the output terminals of the main amplifier. As mentioned above, the "HIGH" level output should be terminated in a 1K, 2W resistor when using the pulse height selector. The PHS dial reads from zero to 100 volts so that it is approximately direct reading, the accuracy being about plus or minus 0.5 volts, and is very nearly independent of either bandwidth setting or pulse rate.

The operation of the pulse height selector may be summarized as follows. V12 is an amplifier biased beyond cutoff. The amount of bias is determined by the setting of R43 and the cathode potential. When V12 is not conducting, its cathode potential is held at approximately plus 93 volts by V13. Pulses from V6 equal to (or slightly less than) the bias as determined by R41, R42, and R43 are amplified and trigger the single-shot multivibrator, V14 and V15. Pulses that exceed the bias do not draw grid current in V12 since the cathode is free to follow the grid in a positive direction. Positive pulses from the multivibrator are differentiated by C23-R54 and applied to the grid of V16, which serves as an output tube and clips the negative pulse from the differentiator.

V11 is a d. c. restorer inserted to keep the measurements of pulse height independent of pulse rate. Whenever the counting loss (due to finite resolving time of the amplifier) becomes appreciable, then the diode restorer should be used. On the other hand the diode complicates the measurement of pulse height when noise is high so that it should be removed when not needed. This rectifying action of the diode on negative noise impulses produces a bias which may be as much as four volts. This bias should be determined for the particular gain setting and subtracted from the DISCRIMINATOR dial readings. Its magnitude is the difference in DISCRIMINATOR dial readings for a given counting rate when V11 is in and out of its socket.

The output of the discriminator is a negative pulse of 45 volts and 0.5 microseconds wide when terminated in a 1K, 2W resistor.

POWER SUPPLY. The amplifier is designed to operate from a 115 volt, 60 cycle line. The gain is independent of the line voltage so that a constant voltage transformer is not necessary.

The amplifier has an electronically regulated 260 volt power supply. Lower voltages for operating some of the stages are obtained by voltage dropping resistors. The filament transformer used in this amplifier has considerably greater current capacity than is actually used and hence produces too high a voltage. This may produce hum in the output, hence voltage dropping resistors have been added. Since it is only the preamp stages that are sensitive to excess voltage, a good solution is to reduce the voltage by adding an r. f. choke in preamp filament supply (Millen 7825) to reduce power line interference in the preamplifier filament supply. It may be noted that the full plate potential appears on the signal lead of the input jack of the preamp. This voltage is provided for the operation of ionization chambers.

The regulated plate voltage should be 265 volts $\pm$ 5 volts. If B plus is less than 260 volts, it will be necessary to increase resistor R63 to 125,000 ohms by selecting this resistor. The B plus should vary approximately one volt for AC inputs between 95 to 120 volts. The heater voltage should be no more than 6.2 volts. The ripple on the B plus should not exceed 0.2 rms. The voltage observed on plates, screens and cathodes are shown in Section V. After its warm up period, the preamplifier should measure 95 volts plus or minus 10 volts, as measured at resistor R65 in the preamp. Saturation of the amplifier should not occur below an output of 95 volts; if saturation does occur at less than 95 volts, V5 will probably be found to be sub-standard in trans-conductance.

SECTION V — MAINTENANCE

See accompanying tables for voltages and resistances. It is advisable to check the overall gain and linearity of the amplifier periodically. It will also be advisable to check all tubes for emission and transconductance at least every 5000 hours of operation, and to replace poor tubes. Especially good tubes should be used in replacing V12 and V13.

A rapid check on the amplifier tubes may be obtained, by measuring with a high resistance voltmeter, the grid potential on each tube. Departure from ground potential will indicate grid current or a leaky coupling condenser. Measurement of voltage across the plate resistor will provide a check on the tube transconductance.

If the filter condensers C27 and C28 develop oil leaks, the leaking condenser should be replaced. The leak is not evidence that the condenser has failed but is failing.

If the positive triggering — no triggering spread on the PHS dial is more than one division and ripple on B plus is low, check condenser C22. This condenser should not be less than 10 micromicrofarads for proper operation of the PHS circuit.

The importance of using a single ground when used with the 219 preamplifier and other equipment can not be overstated.

During any service check the potential drop across resistors R29, R30 and R31 should be measured. It should be about 150 volts. If it is lower, the cathode emission of V5 is probably down due to age. If replacing this tube does not result in the anticipated potential drop, the resistors themselves may have changed.

It is advisable to check the over-all gain of the amplifier occasionally to be sure that it is not changing. A fairly reliable indication can be obtained by turning the amplifier gain to maximum and reducing the PHS dial reading until noise begins to be counted. This will occur at about 10 volts on the 0.5 MC position when the 219 preamplifier is used.

Due to the finite life of the tubes, they should be checked for emission and transconductance approximately every 1000 hours and poor tubes replaced. This procedure is preferable to replacing all the tubes with new ones.

The adjustment of the peaking condenser C14 is not critical and is not likely to require attention unless it is moved or the circuit changed. In that event a signal generator that produces a pulse having a very rapid rise time (.05 μsec.) and slow decay time is connected to the input jack J2 and the amplifier set to the DELAY LINE position. The pulse from the output of the amplifier is connected to a scope with a fast sweep. As the capacitance of C14 is gradually reduced from its maximum value, the rise time of the pulse observed on the scope will become shorter. When C14 becomes too small the output pulse will "ring", i.e. have some fine wiggles or overshoot. This is to be avoided and sets the limit to which C14 may be reduced. Actually the amplifier will operate satisfactorily for most experiments with any setting whatever of C14.

R24C is normally set at its minimum gain position (maximum feedback and highest resistance) point. If additional gain in the second feedback loop is necessary for any reason, the control may be advanced as required.

PULSE RESPONSE of MODEL 219

A step function signal input results in an output signal which rises in less than 0.2 microseconds. The capacitance of the signal lead connecting the preamplifier and amplifier should be kept low when short rise times are required. One can expect the pulses on the DELAY LINE position to be appreciably slowed by a twelve foot cable.

The adjustment of the peaking condenser C3 is not critical and is not likely to require attention unless it is moved or the circuit changed. C3 is adjusted to give the shortest rise time pulse without a wiggle or overshoot in the output pulse. A signal generator with a fast rise time (0.05 μseconds) and slow decay time must be used for calibration purposes.

EXTRANEOUS COUNTS

Extraneous counts are not uncommon with this type of apparatus. Some of the usual sources of such counts will be discussed in this section.

(1) One common source of extraneous counts is breakdown of insulators, particularly those at the input of the preamplifier that have high voltage applied to them. This includes the ceramic coupling condenser to the preamplifier grid, the insulator in the connector and the chamber. These insulators should be carefully cleaned and never touched by the fingers.

Insulator noise is most troublesome when the humidity is high. Amphenol 82-802 and 805 will not give appreciable counts until the voltage is raised to 5000 volts at 90% humidity.

(2) Everything connected to the input grid must be enclosed in a tight metal shield to prevent radiation pick up. The shield must be connected solidly to the preamplifier chassis; ideally the counter or ion chamber should be welded or soldered to the preamplifier or the 82-804 connector. All leads going through the shield must be well filtered and shielded. No wires or posts should stick through the shields to serve as an antenna.

(3) The use of more than one ground is to be avoided whenever possible. The counter or ion chamber should be connected only to the preamplifier chassis. The preamplifier should be connected only to the amplifier (by the shielded power cable). The amplifier chassis may then be grounded to the power line. In some cases it may be impossible to keep from grounding the ionization chamber or counter. In this event the amplifier and associated equipment should not be grounded and their connections to the power line should be isolated by means of a properly designed filter.

MODEL 219 LINEAR PREAMPLIFIER
and
MODEL 218 LINEAR AMPLIFIER

MODEL 219 PREAMPLIFIER

TUBE	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7
V1	V 0 R 100M	V 1.1 R 250	V 6.3AC* R 0	V 6.3AC* R 0	V 70 R 10K	V 65 R 35K	V 1.1 R 250
V2	V 0 R 1M	V 1.8 R 450	V 6.3AC* R 0	V 6.3AC* R 0	V 58 R 10K	V 88 R 0	V 1.8 R 450
V3	V 12 R 1M	V 17 R 2600	V 6.3AC* R 0	V 6.3AC* R 0	V 88 R 0	V 88 R 100	V 17 R 2600
V4	V 17 R 3K	V 17 R ∞	V 6.3AC* R 0	V 6.3AC* R 0	V 88 R 0	V 88 R 100	V 17 R ∞

JACK J3 TERMINALS			
A	V 0 R 0	E	V 0 R ∞
C	V 265 R 40K	F	V 6.3AC R 0
D	V 90 R 0	G	V 0 R 0

Voltage measurements are made with the unit connected for normal operation. Resistance measurements above are taken with unit disconnected and pin D (+90V) of Jack J3 grounded.

V indicates d-c voltage to ground unless otherwise specified.

R indicates resistance to ground unless otherwise specified.

* A-C voltage indicated is measured between pins marked with an asterisk on the same horizontal line.

MODEL 218 LINEAR AMPLIFIER

	JACK J2 TERMINALS					
	A	V 0 R ∞	E	V 0 R 2K		
	B	- -	F	V 0 R ∞		
	C	V 265 R 0	G	V 0 R 0		
	D	V 90 R 10K				
JACK	J3	J4	J6	J8	J9	J10
RESISTANCE	2K	∞	80	∞	4.7K	150

Fig. V-1 Table of Model 218 and 219 Voltages & Resistances

MODEL 218 LINEAR AMPLIFIER (CONT.)

TUBE	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9
V1	V 0 R 0	V 6.3AC* R 0	V 0 R 0	V 0 R 1.7K	V 1.5 R 140	V 120 R 17K	V 6.3AC* R 0	V 118 R 12.5K	- -
V2	V 0 R 0	V 6.3AC* R 0	V 0 R 0	V 0 R 22K	V 1.8 R 140	V 120 R 17K	V 6.3AC* R 0	V 94 R 12.5K	- -
V3	V 0 R 0	V 6.3AC* R 0	V 0 R 0	V 0 R 1M	V 4 R 640	V 180 R 2.4K	V 6.3AC* R 0	V 180 R 3K	- -
V4	V 0 R 0	V 6.3AC* R 0	V 0 R 0	V 0 R 22K	V 1.6 R 175	V 100 R 17.5K	V 6.3AC* R 0	V 126 R 20K	- -
V5	V 0 R 0	V 6.3AC* R 0	V 0 R 0	V 0 R 47K	V 2 R 51	V 100 R 17.5K	V 6.3AC* R 0	V 87 R 6K	- -
V6	V 260 R 45	V 0 R 220K	V 15 R 4K	V 6.3AC* R 0		V 15 R 4K	V 0 R 220K	V 6.3AC* R 0	V 260 R 45
V7	- -	V 5AC* R ∞	- -	V 600 R 90	- -	V 600 R 90	- -	V 5AC* R ∞	- -
V8	V 220 R 150K	V 360 R ∞	V 260 R 0	V 220 R 150K	V 360 R ∞	V 260 R 0	V 6.3AC* R ∞	V 6.3AC* R ∞	- -
V9	- -	V 6.3AC* R ∞	V 150 R 30K	V 150 R 64K	V 150 R 30K	V 205 R 15K	V 6.3AC* R ∞	V 220 R 150K	- -
V10	- -	V 0 R 0	- -	- -	V 150 R 30K	- -	- -	- -	- -
V11	- -	V 88 R 0	V 6.3AC* R 0	V 6.3AC* R 0	V 88 R 1M	- -	- -	- -	- -
V12	V 88 R 1M	V 110 R 24K	V 6.3AC* R 0	V 6.3AC* R 0	V 260 R 6.5K	V 260 R 0	V 110 R 24K	- -	- -
V13	V 97 R 40K	V 110 R 24K	V 6.3AC* R 0	V 6.3AC* R 0	V 260 R 0	V 260 R 100	V 110 R 24K	- -	- -
V14	V 42 R 520K	V 45 R 5.K	V 6.3AC* R 0	V 6.3AC* R 0	V 120 R 15K	V 145 R 12K	V 45 R 5K	- -	- -
V15	V 36 R 52K	V 45 R 5.K	V 6.3AC* R 0	V 6.3AC* R 0	V 145 R 12K	V 145 R 12K	V 45 R 5K	- -	- -
V16	- -	V 6.3AC* R 0	V 5.7 R 2.2K	V 0 R 4.5K	V 5.7 R 2.2K	V 250 R 20K	V 6.3AC* R 0	V 250 R 4.8K	- -

Voltage measurements above are made with the unit connected for normal operation and controls set as specified below:

BANDWIDTH Switch S1 at DELAY LINE
COARSE GAIN Switch S2 at 64
2nd Loop Gain Control R24C at full CCW
PULSE HEIGHT Control R43 at full CCW

Resistance measurements are made with the unit disconnected, controls set as above, and pin C of PREAMP Jack J2 grounded.

V indicates d-c voltage to ground unless otherwise specified.

R indicates resistance to ground unless otherwise specified.

* A-C voltage indicated is measured between pins marked with an asterisk on the same horizontal line.

Fig. V-1 Table of Model 218 and 219 Voltages & Resistances

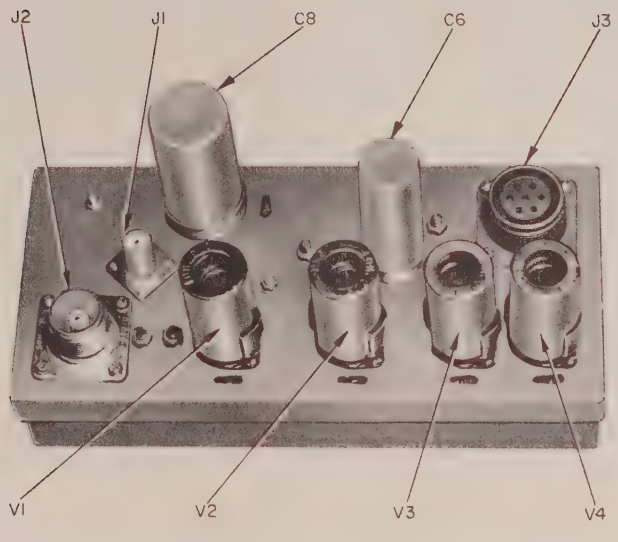


Fig. V-2 Model 219 Preamplifier, Top View: Location of Components

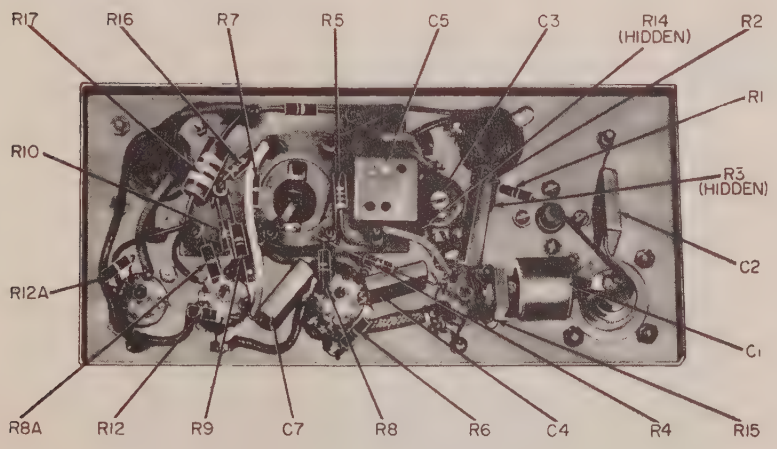


Fig. V-3 Model 219 Preamplifier, Bottom View: Location of Components

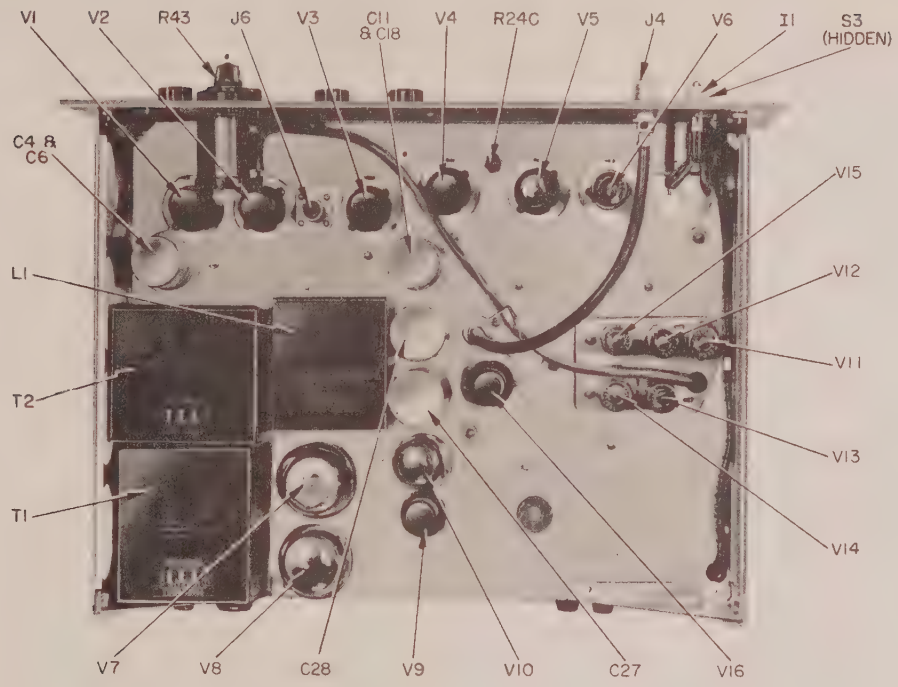


Fig. V-4 Model 218 Top View: Location of Components

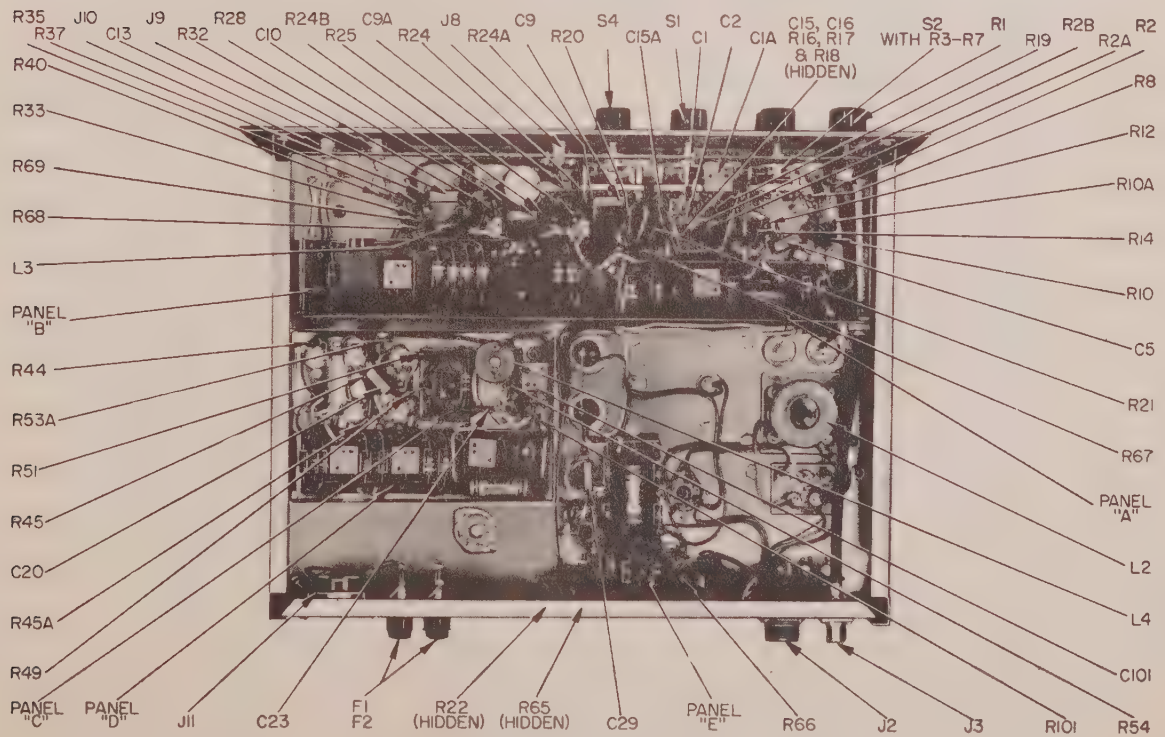


Fig. V-5 Model 218 Bottom View: Location of Components

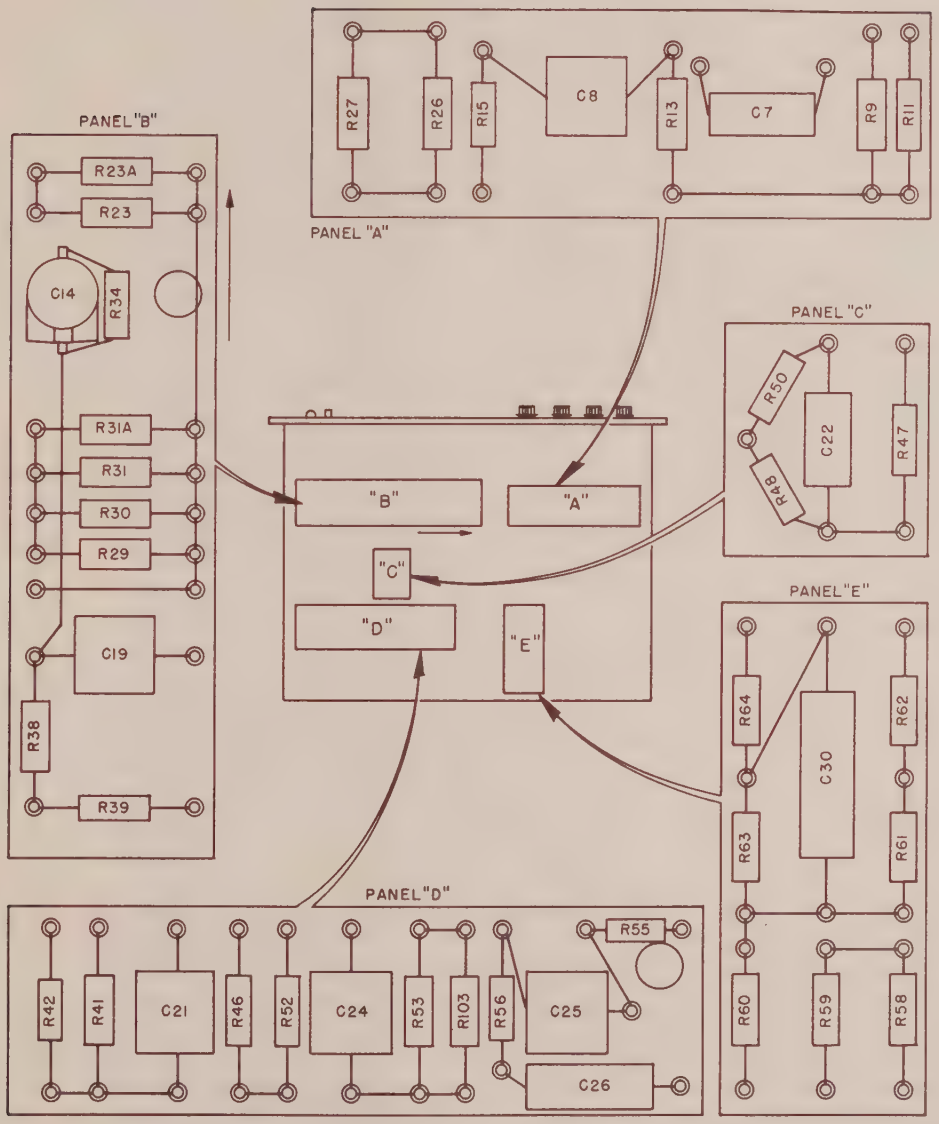


Fig. V-6 Model 218 Component Boards: Location of Components

C	1	1000 mmf, ceramic, 5 KV	CC 102-4
	2	Omitted	
	3	2-7.5 mmf, (variable), ceramic, 500 V	CV 080-1
	4	470 mmf, mica, 500 V	CM 471-1
	5	.01 mf, disc, 500 V	CC 103-1
	6	25 mf, electrolytic, 25 V	CE 256-1
	7	3300 mmf, mica, 500 V	CM 332-1
	8	20 mf, electrolytic, 450 V	HD-48
J	1	Receptacle, BNC IPC 27000	JK-1
	2	Receptacle, HN 82-805	JK-21
	3	Receptacle, AN3102-16S (7 pin), female	JK-31
R	1	1 Meg., 5%, ½ W, comp.	RCE 105-J
	2	100 Meg., 5%, ½ W, comp.	RCE 107-J
	3	270 Ω, 5%, ½ W, comp.	RCE 271-J
	4	10 K, 5%, ½ W, comp.	RCE 103-J
	5	33 K, 5%, ½ W, comp.	RCE 333-J
	6	1 Meg., 5%, ½ W, comp.	RCE 105-J
	7	470 Ω, 5%, ½ W, comp.	RCE 471-J
	8	10 K, 5%, ½ W, comp.	RCE 103-J
	8A	100 Ω, 5%, ½ W, comp.	RCE 101-J
	9	1 Meg., 5%, ½ W, comp.	RCE 105-J
	10	270 Ω, 5%, ½ W, comp.	RCE 271-J
	11	Omitted	
	12	470 Ω, 5%, ½ W, comp.	RCE 471-J
	12A	100 Ω, 5%, ½ W, comp.	RCE 101-J
	13	Omitted	
	14	8200 Ω, 5%, ½ W, comp.	RCE 822-J
R	15	100 Ω, 5%, ½ W, comp.	RCE 101-J
	16	3300 Ω, 5%, ½ W, comp.	RCE 332-J
	17	8500 Ω, 10%, 10 W, wirewound	RW 852-1
V	1	6AK5	
	2	6AK5	
	3	6AK5	
	4	6AK5	

Model 219B Parts List

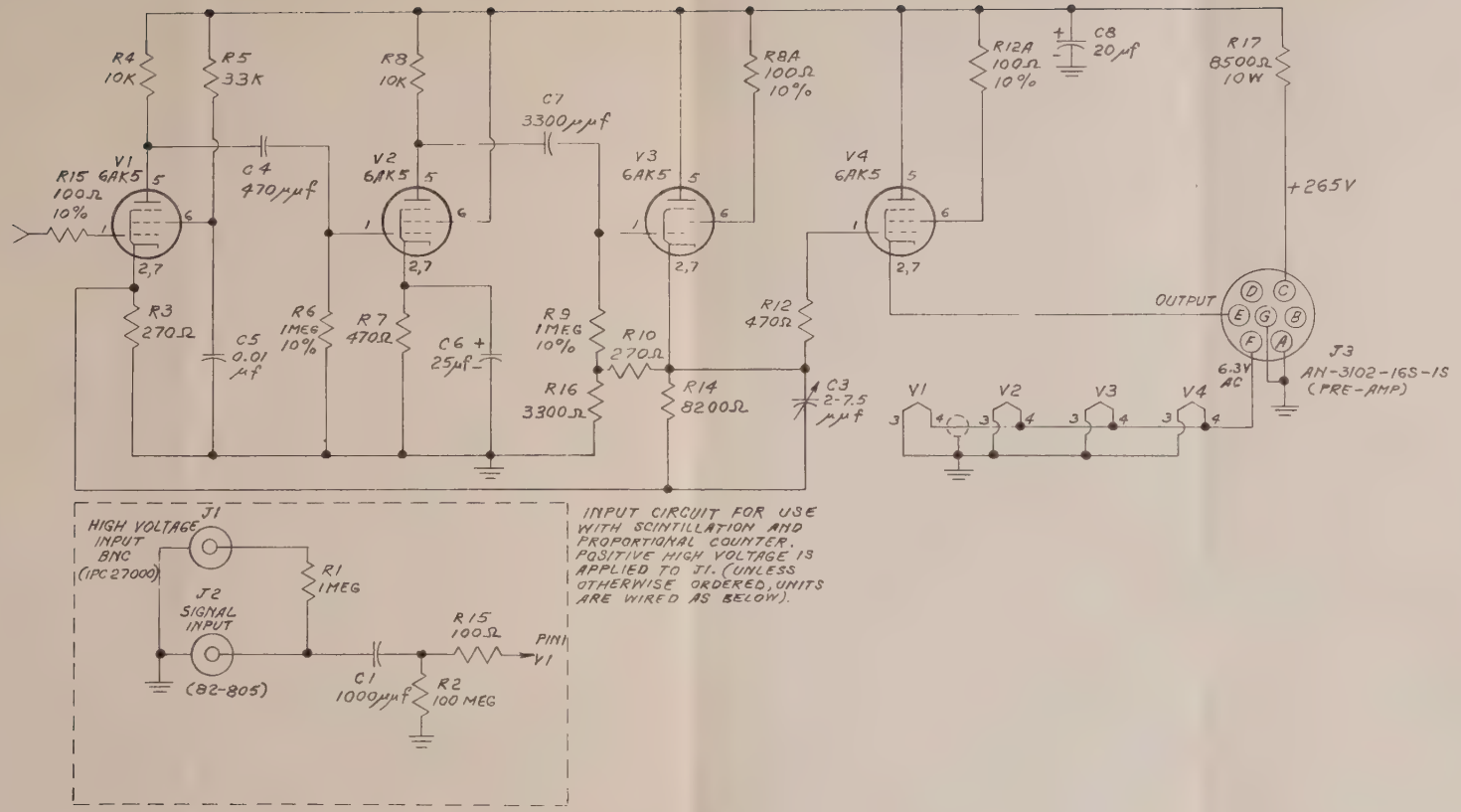
Note: same as for 219 with additions listed below. C1 in the parts list above is designated C101 on schematic for 219B. Similarly for other parts.

R112A	470 Ω, 5%, ½ W, comp.	RCE 471-J
R118	2 K, 5%, ½ W, comp.	RCE 202J
V104	6J6	

C	1	1000 mmf, mica, 500 V	CM 102-2
	1A	2400 mmf, mica, 500 V	CM 242-1
	2	.01 mf, mica, 500 V	CM 103-1
	3	10 mmf, mica, 500 V (see schematic note 3)	CM 101-1
	4	40-40 mf, electrolytic, 450 V	CE 406-1
	5	.01 mf, mica, 500 V	CM 103-1
	6	40-40 mf, electrolytic, 450 V	CE 406-1
	7	25 mf, electrolytic, 50 V	CE 256-2
	8	.01 mf, mica, 500 V	CM 103-1
	9	.01 mf, mica, 500 V	CM 103-1
	9A	.01 mf, mica, 500 V	CM 103-1
	10	5600 mmf, mica, 500 V	CM 562-2
	11	40-40 mf, electrolytic, 450 V	CE 406-1
	12	Omitted	
	13	.01 mf, mica, 500 V	CM 103-1
	14	2-7 mmf, trimmer ceramic, 500 V	CV 080-1
	15	22 mmf, mica, 500 V	CM 220-1
	15A	1.8 mmf, ceramic, 500 V	CC 180-2
	16	100 mmf, mica, 500 V	CM 101-1
	17	Omitted	
	18	40-40 mf, electrolytic, 450 V	CE 406-1
	19	.01 mf, mica, 500 V	CM 103-1
	20	.01 mf, mica, 500 V	CM 103-1
	21	.01 mf, mica, 500 V	CM 103-1
	22	10 mmf, mica, 500 V	CM 100-1
	23	22 mmf, mica, 500 V	CM 220-1
C	24	.01 mf, mica, 500 V	CM 103-1
	25	.01 mf, mica, 500 V	CM 103-1
	26	.1 mf, mylar, 600 V	CP 104-11
	27	4 mf, mylar, 600 V	CP 405-1
	28	4 mf, mylar, 600 V	CP 405-1
	29	1000 mmf, mica, 500 V	CC 102-1
	30	.1 mf, mylar, 600 V	CP 104-11
	101	.01 mf, mica, 500 V	CM 103-1
F	1	2.0 amp, 125 V, 3 AG	FS-14
	2	2.0 amp, 125 V, 3 AG	FS-14
I	1	Pilot Light Assembly, 115 VAC	LA-7
J	2	Receptacle, 7 pin, female	JK-31
	3	Receptacle with hood, small UHF coaxial	JK-3
	4	Receptacle with hood, small UHF coaxial	JK-3
	6	Receptacle, small UHF coaxial	JK-3
	8	Receptacle, small UHF coaxial	JK-3
	9	Receptacle, small UHF coaxial	JK-3
	10	Receptacle, small UHF coaxial	JK-3
	11	Power receptacle, 2 pin, male	JK-11
L	1	Choke, 8.5 hy, 0.125 amp.	LF-13
	2	Choke, 0.6 mh, 2 amp, 75 ohms	LR-4
	3	Choke, 250 hy.	LR-2
	4	Choke, 0.5 mh.	LR-9
P	6	Plug, UHF small coaxial	PL-1

Part No.			BA No.
R	1	1000 Ω, 10%, 2 W, comp.	RV 102-4
	2	1000 Ω, 5%, ½ W, comp.	RCE 102J
	2A	2000 Ω, 5%, ½ W, comp.	RCE 202J
	2B	150 Ω, 5%, ½ W, comp.	RCE 151J
	3	800 Ω, 2%, ½ W, comp.	RF 801-3
	4	400 Ω, 2%, ½ W, comp.	RF 401-3
	5	200 Ω, 2%, ½ W, comp.	RF 201-3
	6	100 Ω, 2%, ½ W, comp.	RF 101-5
	7	50 Ω, 2%, ½ W, comp.	RF 500-3
	8	50 Ω, 2%, ½ W, comp.	RF 500-3
	9	10 K, 5%, 2 W, comp.	RCH 103J
	10	150 Ω, 5%, 1 W, comp.	RCG 151J
	10A	100 Ω, 5%, ½ W, comp.	RCE 101J
	11	15 K, 5%, 1 W, comp.	RCG 153J
	12	22 K, 5%, ½ W, comp.	RCE 223J
	13	10 K, 5%, 2 W, comp.	RCH 103J
	14	150 Ω, 5%, 1 W, comp.	RCG 151J
	15	1 Meg., 5%, ½ W, comp.	RCE 105J
	16	18 K, 5%, ½ W, comp.	RCE 183J
	17	39 K, 5%, ½ W, comp.	RCE 393J
	18	82 K, 5%, ½ W, comp.	RCE 823J
	19	1000 Ω, 5%, ½ W, comp.	RCE 102J
	20	680 Ω, 5%, ½ W, comp.	RCE 681J
	21	680 Ω, 5%, 1 W, comp.	RCG 681J
	22	2500 Ω, 10%, 10 W, wirewound	RW 252-2
R	23	39 K, 10%, 2 W, comp.	RCH 393J
	23A	39 K, 10%, 2 W, comp.	RCH 393J
	24	22 K, 5%, ½ W, comp.	RCE 223J
	24A	100 Ω, 5%, ½ W, comp.	RCE 101J
	24B	390 Ω, 5%, ½ W, comp.	RCE 391J
	24C	2000 Ω, 10%, 2 W, comp., pot.	RV 202-1
	25	200 Ω, 5%, 1 W, comp.	RCG 201J
	26	33 K, 5%, 2 W, comp.	RCH 333J
	27	39 K, 10%, 2 W, comp.	RCH 393J
	28	47 K, 5%, ½ W, comp.	RCE 473J
	29	24 K, 5%, 2 W, comp.	RCH 243J
	30	24 K, 5%, 2 W, comp.	RCH 243J
	31	24 K, 5%, 2 W, comp.	RCH 243J
	31A	24 K, 5%, 2 W, comp.	RCH 243J
	32	51 Ω, 10%, 1 W, comp.	RCG 510K
	33	100 Ω, 5%, ½ W, comp.	RCE 101J
	34	18 K, 5%, 1 W, comp.	RCG 183J
	35	100 Ω, 5%, ½ W, comp.	RCE 101J
	36	Omitted	
	37	220 K, 5%, ½ W, comp.	RCE 224J
	38	4700 Ω, 10%, 2 W, comp.	RCH 472J
	39	150 Ω, 5%, 1 W, comp.	RCG 151J
	40	100 Ω, 5%, ½ W, comp.	RCE 101J
	41	91 K, 5%, 2 W, comp.	RCH 913J
	42	750 Ω, 5%, 1 W, comp.	RCG 751J
	43	50 K, helipot, 1%, 5 W,	RA-503-3
R	44	1 Meg., 5%, ½ W, comp.	RCE 105J
	45	6800 Ω, 5%, ½ W, comp.	RCE 682J

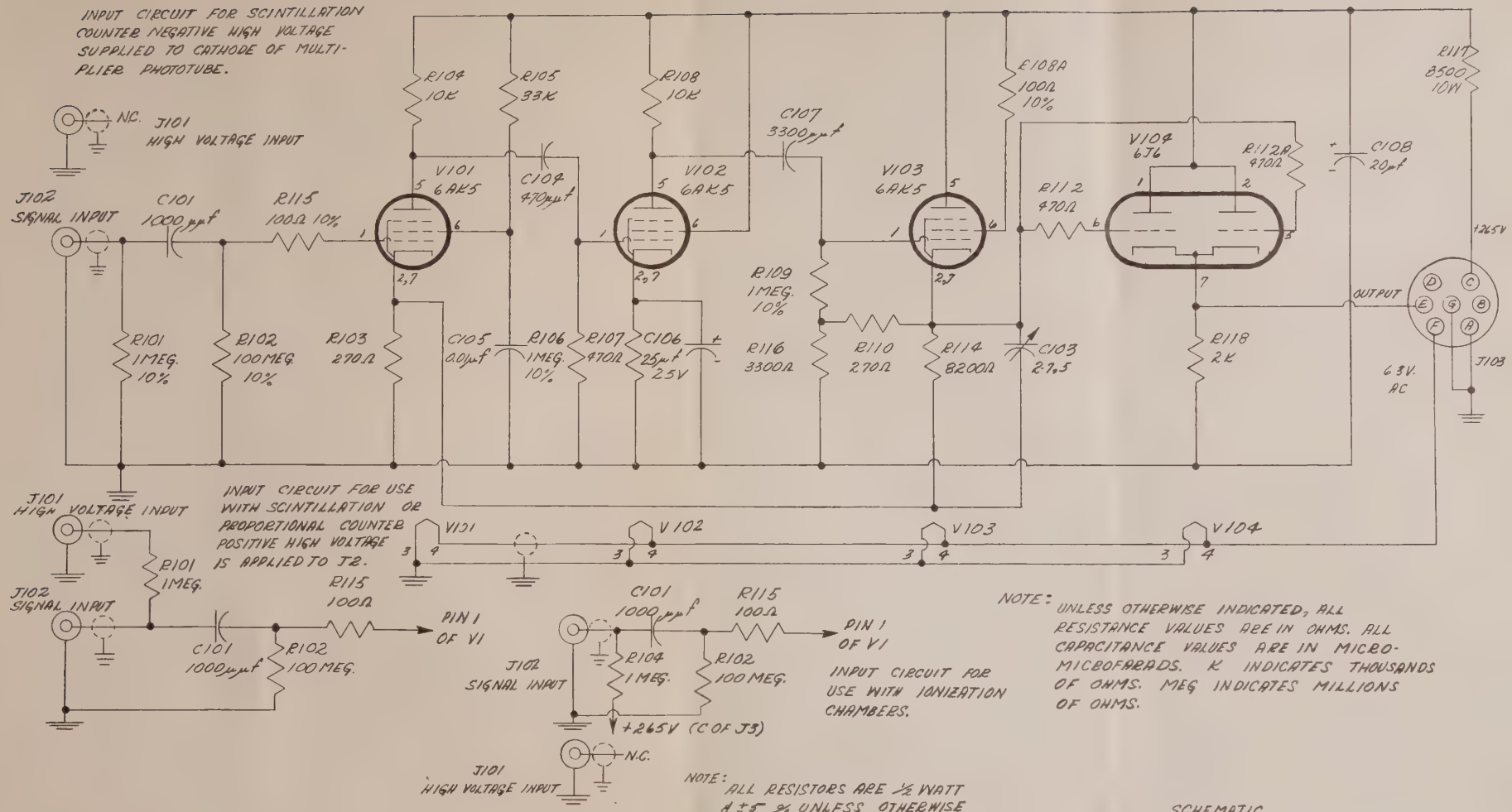
Part No.			BA No.
	45A	100 Ω, 5%, ½ W, comp.	RCE 101J
	46	24 K, 5%, 1 W, comp.	RCG 243J
	47	3300 Ω, 5%, 1 W, comp.	RCG 332J
	48	150 K, 5%, ½ W, comp.	RCE 154J
	49	510 K, 5%, ½ W, comp.	RCE 514J
	50	15 K, 5%, ½ W, comp.	RCE 153J
	51	75 K, 5%, ½ W, comp.	RCE 753J
	52	4700 Ω, 5%, 1 W, comp.	RCG 472J
	53	24 K, 5%, 2 W, comp.	RCH 243J
	53A	100 Ω, 5%, ½ W, comp.	RCE 101J
	54	4700 Ω, 5%, ½ W, comp.	RCE 472J
	55	20 K, 5%, ½ W, comp.	RCE 203J
	56	2200 Ω, 10%, ½ W, comp.	RCE 222K
	57	Omitted	
	58	47 Ω, 5% 1 W, comp.	RCG 470J
	59	47 Ω, 5% 1 W, comp.	RCG 470J
	60	150 K, 5%, 1 W, comp.	RCG 154J
	61	15 K, 5%, 1 W, comp.	RCG 153J
	62	15 K, 5%, 1 W, comp.	RCG 153J
	63	120 K, 5%, 1 W, comp.	RCG 124J
	64	150 K, 5%, 1 W, comp.	RCG 154J
	65	33 K, 5%, 2 W, comp.	RCH 333J
	66	220 Ω, 5%, ½ W, comp.	RCE 221J
	67	680 Ω, 5%, ½ W, comp.	RCE 681J
	68	47 Ω, 5%, ½ W, comp.	RCE 410J
R	69	47 Ω, 5%, ½ W, comp.	RCE 410J
	70	20 K, 5%, 1 W, comp.	RCG 203J
	101	4.7 K, 5%, ½ W, comp.	RCE 472J
	103	24 K, 5%, 2 W, comp.	RCH 243J
S	1	Rotary, ceramic, 2 pole, 5 positions	SR-29
	2	Rotary, ceramic, 1 pole, 6 positions	SR-28
	3	DPDT, toggle	SR-29
	4	Rotary, ceramic, 1 pole, 6 positions	SR-28
T	1	Power transformer; 115 V input; outputs: 750 V center tapped, 6.3 V at 3 amp., 6.3 V at 0.7 amp., 5 V at 3 amp.	TP-35
	2	Filament transformer; 115 V input; outputs: 6.3 V at 9 amp., 6.3 V at 0.6 amp., 6.3 V at 0.6 amp.	TF-13
V	1	6SJ7, sharp-cutoff pentode	6SJ7
	2	6AC7, pentode amplifier	6AC7
	3	6AC7, pentode amplifier	6AC7
	4	6AC7, pentode amplifier	6AC7
	5	6AG7, power pentode	6AG7
	6	5687, twin triode	5687
	7	5U4G, full-wave rectifier	5U4G
	8	6AS7, low-mu twin-power pentode	6AS7
	9	6AC7, pentode amplifier	6AC7
	10	VR150, voltage regulator	VR150
	11	6AL5, twin diode	6AL5
	12	6AK5, RF amplifier pentode	6AK5
	13	6AK5, RF amplifier pentode	6AK5
	14	6AK5, RF amplifier pentode	6AK5
V	15	6AK5, RF amplifier pentode	6AK5
	16	6AC7, pentode amplifier	6AC7
Z	1	Delay line, RG65/U, 0.5 microseconds	DL-4



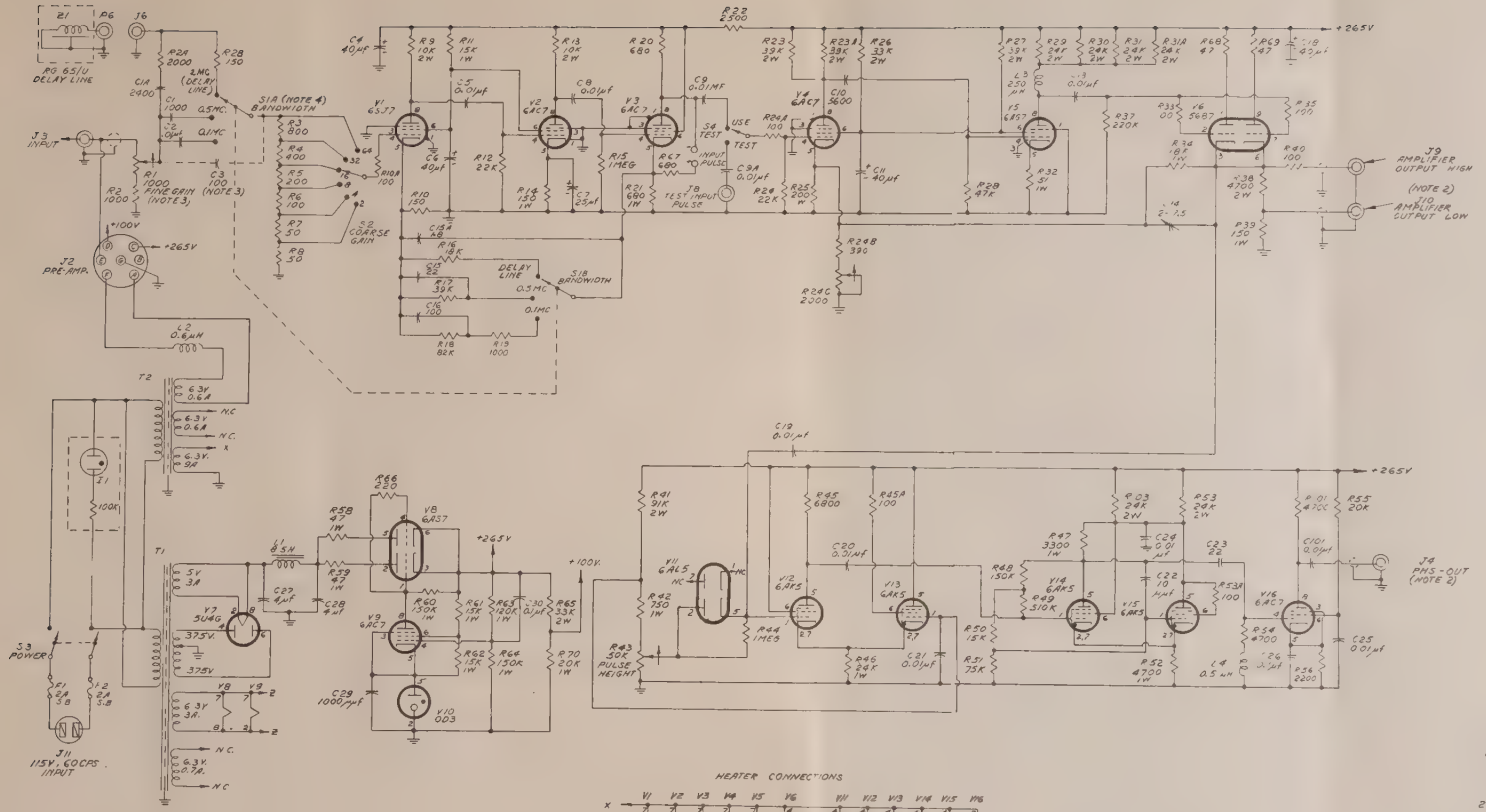
INPUT CIRCUIT FOR USE WITH SCINTILLATION AND PROPORTIONAL COUNTER. POSITIVE HIGH VOLTAGE IS APPLIED TO J1. (UNLESS OTHERWISE ORDERED, UNITS ARE WIRED AS BELOW).

UNLESS NOTED ALL RESISTORS ARE 1/2 WATT AND ± 5 %

SCHEMATIC
PREAMPLIFIER
MODEL 219A



PRE AMPLIFIER SCHEMATIC (LONG OUTPUT CABLE)
MODEL 219B
AND MODEL 219R

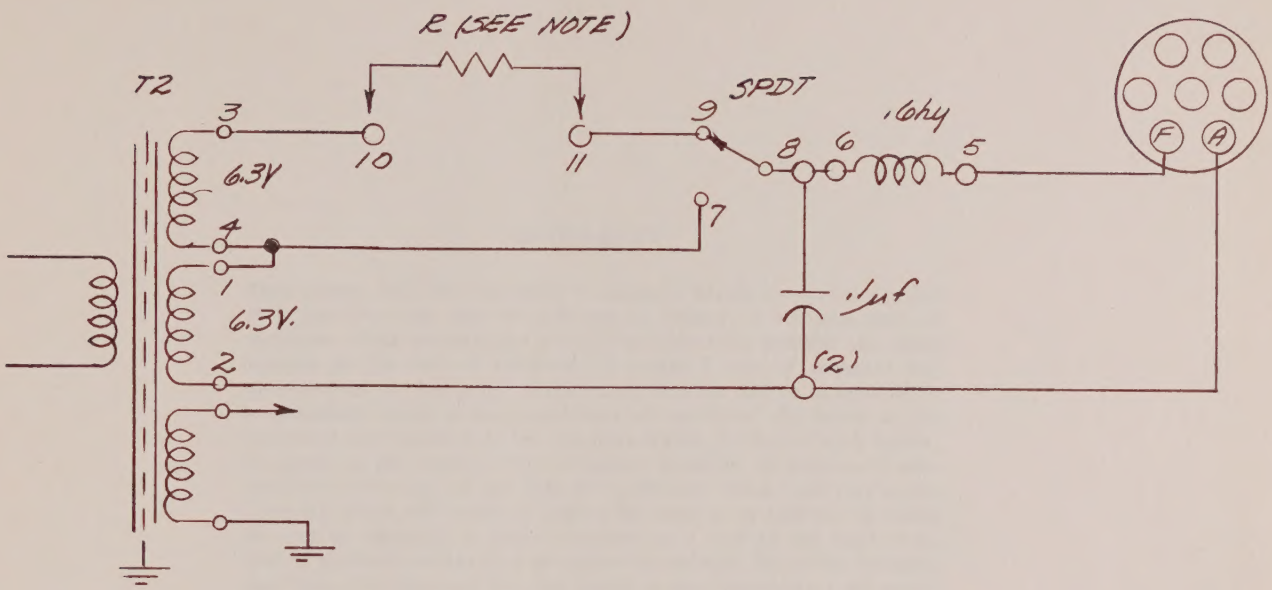


NOTES

1. UNLESS OTHERWISE INDICATED - ALL RESISTANCE VALUES ARE IN OHMS ALL CAPACITANCE VALUES ARE IN MICRO-MICROFARADS. "K" INDICATES THOUSANDS OF OHMS. "MEG" INDICATES MILLIONS OF OHMS
2. IF MODEL 218 IS NOT USED WITH THE MODEL 331, OUTPUTS FROM J9 & J4 SHOULD LOOK INTO 1000 OHMS
3. C3 USED ONLY WHEN RC DIFFERENTIATION IS DESIRED IN LIEU OF DELAY LINE DIFFERENTIATION
4. REMOVE DELAY LINE Z1 WHEN BANDWIDTH SWITCH S1 IS SET AT 0.5MC OR 0.1MC.

UNLESS NOTED ALL RESISTORS ARE 1/2 WATT AND ± 5%

SCHEMATIC
LINEAR AMPLIFIER
MODEL 218



NOTES

1. SWITCH IN POSITION 7, HEATER VOLTAGE FOR UP TO 6 FOOT CABLE LENGTH.
2. SWITCH IN POSITION 9, AND R = 3Ω. 5W FOR 100FT CABLE
   R = 4.5Ω 10W FOR 50FT. CABLE

SEE SCHEMATIC, DWG. NO. 218-1 FOR BASIC CIRCUIT.

MODIFICATION OF HEATER SUPPLY
FOR LONG CABLES - MODEL 218

WARRANTY

Baird-Atomic, Inc. (the "Company"), warrants this equipment for a period of 1 year from the date of shipment as follows: it warrants that all equipment of its manufacture is free from defects in material and workmanship at the time of shipment. If within 1 year of shipment any equipment of the Company's manufacture develops defects in material or workmanship under normal conditions of operation, the buyer of the equipment may return it to the Company within 30 days of such failure, for repairs at the expense of the Company, including the expense of shipment, or in the case of any defective part may return such part to the Company which will repair or replace the same at its expense, including the cost of shipment. A further warranty of 1 year on the same terms shall be applicable to any part so repaired or replaced. Except for Dekatron glow tubes, this warranty does not extend to stock components not manufactured by the Company.

The Company shall not be liable for damage or destruction of instruments during delivery or caused by other than employees of Baird-Atomic, Inc.; in any event, liability shall not exceed the cost of replacement of defective parts upon prompt notification of such defect.

For return of equipment or any part thereof under the terms of the foregoing warranty a letter should be forwarded to Baird-Atomic, Inc., Attention: Sales Service Department, 33 University Road, Cambridge 38, Massachusetts. It should state owner's name and address; model and serial number of the equipment; the order number, under which it was purchased; the date of failure and a description of the circumstances surrounding same. Upon receipt of such information, shipping instructions for return of equipment or parts thereof will be forwarded promptly.

Baird-Atomic, Inc.

33 UNIVERSITY ROAD, CAMBRIDGE, MASS

PRINTED IN U.S.A.

SB